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101900-42-L

14 November 1974

(E75-10040) DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Progress Report, Oct. 1974 (Environmental Research Inst. of Michigan) 4 p HC $3.25 CSCL 05B G3/43

N75-12409

Unclas 00040

Developing Processing Techniques for Skylab Data
Monthly Progress Report October 1974

EREP Investigation 456 M
NASA Contract NAS9-13280

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Developing Processing Techniques for Skylab Data
Monthly Progress Report, October 1974

The following report serves as the twentieth monthly progress report for EREP Investigation 456 M which is entitled "Developing Processing Techniques for Skylab Data". The financial report for this contract (NAS9-13280) is being submitted under separate cover.

The purpose of this investigation is to test information extraction techniques for SKYLAB S-192 data and compare with results obtained in applying these techniques to ERTS and aircraft scanner data.

During the previous three months, we had performed some analysis on the S-192 data set of the Michigan Test Site, which had been provided through ERIM's EOS systems study. The results of this effort showed that the data product we were working with, which is an interim data product only, exhibited a very small dynamic range in the data, such that differences in signals between object classes are close to or less than the basic quantizing level on the data tape. Such data severely limits any analysis effort. Therefore, it was decided to suspend processing on the interim data product and await the arrival of the final EREP data product which, it is hoped, will be far more viable for processing.

While we had not yet received the SKYLAB S-192 data for processing for this study, we were able during this reporting period to continue our analysis of aircraft collected multispectral scanner data. This data was collected by the ERIM M-7 scanner over an intensive study area of the Michigan Test Site the same morning as the SKYLAB overpass.

After reviewing all the information available, it was decided to initially process data from only one aircraft pass. Experience with one data set would then indicate which additional data should be processed and in what manner.

The data set selected is Run 2 and was collected over Flight line 1 of the intensive study effort at an altitude of 2000 feet. The time of data collection was 1100 hours EDT, approximately 35 minutes after the SKYLAB overpass.

First the analog tape was duplicated to remove relative skew between channels, and the tape was reviewed in regard to data quality. The scan rate was checked and found to be 60 cycles per second as per specifications.

The relative ground speed of the aircraft was checked and found to be approximately 2.75 feet/scan or 98 knots. Each data channel was checked. The only problem found was in the thermal channel, track 12, where the offset was very noisy, bouncing the cold plate signal around by as much as 15% of the total dynamic range.

As mentioned above, the data were gathered at an altitude of 2000 feet. This means that the ground size of each resolution element is very small compared to the size of ground objects of interest; or conversely, that each ground object of interest would contain an enormous number of resolution elements. For example, the spectrometer on the M-7 scanner exhibits a resolution of two milliradians, resulting in a resolution element of four feet by four feet. A typical 15 acre agricultural field would be scanned by as many as 40,875 resolution elements.

Accordingly, it was felt that we could take advantage of the gross redundancy in the data by means of spatial filtering to improve the signal to noise ratio of the data, decrease considerably the number of pixels to be processed, thus decreasing processing time and costs. Naturally, some information, such as the ability to more precisely locate boundaries between two areas or detect fine-scale structure in the data, would be last in using such filtering. For this data set, it was felt that such drawbacks would not hurt the analysis effort. Accordingly, it was decided to filter along each scan line using an appropriate low pass analog filter and sampling once every 20 milliradians. In addition digital smoothing over 9 scan lines was used at each scan point. The result was one digitized "average" data point from every 10x9 rectangle of data points in the original analog tape. This represents an increase in signal to noise of 9.5:1 and a large decrease in the volume of data that need by processed. In addition, this sampling scheme allowed the data to be digitized eight times faster than it could have been done had we digitized every point in the scan line. In all, some 40,000 analog data scan lines (representing approximately 21 miles on the ground) were digitized. Each digitized scan line consisted of 85 points of ground scene, and an additional 55 points of calibration information.

After digitizing, the data was again checked for any unusual problems (noise, skew between channels, dropouts, etc.); none were found. The data were then dynamically clamped to the zero signal reference source (cold plate for the thermal channel and dark level for the other channels), i.e., processed to reduce any changes in the offset of each channel by calculating for each scan line the average values of the reference area for each of the channels, then subtracting these values from all points in the scan line.

In the following month, we plan to continue preprocessing of the data by analyzing the average signal as a function of scan angle. Then we plan to begin the training process by extracting signatures from certain analyst-chosen areas and also by using unsupervised classification (clustering) techniques.

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